Experts Weigh in on Fukushima Cleanup

Now that Tokyo Electric Power Co. (Tepco) has revealed that the cores have melted in all three of the Fukushima Daiichi units operating at the time of the March 11 earthquake and ensuing tsunami, experts have begun weighing in on what it will take to clean up the plant site and the surrounding communities. Radiation (primarily in the form of cesium-137) from the plant has reportedly spread over 600 square kilometers near the plant, at levels that will require at the very least some soil cleanup before residents can return, according to early reports.

In a discussion conducted over the online networking site LinkedIn, decontamination and decommissioning experts projected a cleanup effort that will cost between $10 billion and $20 billion (U.S.), will take 10 years at a minimum, will involve 10 000 cleanup personnel whose health will have to be monitored for 20 or more years, and may result in some 1000 homes that will be deemed uninhabitable. The skilled use of robotics, however, could reduce the number of cleanup personnel needed, and new developments in technology could also make a difference. For example, some suggested that robotics could be used for early decontamination efforts, to bring radiation levels down to where it is safe for humans to begin D&D work.

What to do with the resulting waste from the cleanup will be another problem for Tepco, experts agreed. Here again, new technologies in waste treatment, incineration, and volume reduction may be able to help. Many experts agreed that emergency situations can stimulate research and development into new and advanced D&D technologies.

Texas Legislature Approves Out-of-Compact LLW Disposal at WCS Facility

The Texas legislature has approved legislation that will allow the disposal of some out-of-compact low-level waste at the Waste Control Specialists (WCS) disposal facility in Andrews County, Texas. The legislation will allow the 36 states that do not currently have access to class B and C LLW disposal to use the Texas facility. However, no more than 30 percent of the facility's capacity will be made available to non-compact waste, while 56 percent will be allocated to waste from Texas and 14 percent to waste from Vermont. (Texas and Vermont are the two member states of the Texas Low-Level Radioactive Waste Compact.) The legislation also allows WCS to determine the disposal fees to be charged. The bill bans acceptance of waste of international origin for disposal at the facility.

WCS will not be allowed to accept more than 50 000 cubic feet of non-compact waste annually, and will not be able to accept an average of more than 120 000 curies of radioactivity of non-compact waste annually over the first ten years of operation. Waste generators in all states have access to EnergySolutions' Clive, Utah, disposal site, which is limited to Class A (the least radioactive) LLW. Waste generators in 14 states (those in the Atlantic, Northwest, and Rocky Mountain compacts) have access to disposal facilities in Washington state and South Carolina that accept all classes of LLW. In the United States, it is estimated that between 15 000 and 20 000 cubic feet of Class B and C waste is generated annually.

Being able to accept waste from outside the states of Texas and Vermont was considered essential if the disposal facility was to operate cost-effectively. According to WCS Chief Executive Officer William J. Lindquist, "The Texas Legislature put the best interests of Texas consumers and ratepayers first by devising a way to keep disposal costs low for Texas generators while providing tens of millions of dollars annually for the state budget through a voluntary access surcharge paid by generators outside the Texas Compact states of Texas and Vermont."

The WCS disposal facility is currently under construction and is expected to begin operations later this year.

House Science Committee Report on Yucca Mountain Blasts Administration

On June 8, the U.S. House of Representatives' Committee on Science, Space and Technology released a report, "Yucca Mountain: The Administration's Impact on U.S. Nuclear Waste Management Policy," outlining findings from numerous document requests and official correspondence between committee members and administration officials over the last two and a half years regarding the termination of Yucca Mountain as a nuclear waste repository. According to a committee press release, the report details "the complete absence of scientific information and analysis used to support the shutdown decision, and reviews administration actions in the context of promises and specific guidelines on scientific integrity, openness,

and transparency set forth by President Obama and senior administration officials."

The committee noted that the results of this review outline a systematic and active effort on the part of the administration to "obfuscate, delay, and muzzle scientific and technical information and related processes" in order to shut down Yucca Mountain. The report states: "These actions not only violated the president's own highly promoted principles and directives on scientific integrity, transparency, and openness, but they have increased taxpayer liabilities under the Nuclear Waste Policy Act, left nuclear waste sitting at reactor sites across the country with no plan for disposal, and ultimately threatened the long-term potential of nuclear power to meet America's growing energy demands with safe, clean, and affordable base-load electricity."

As stated in the report's executive summary, committee Republicans "reviewed in depth administration actions associated with the Yucca Mountain Project and disposal of the nation's spent nuclear fuel and high-level radioactive waste. . . . The results of this review are striking. Despite numerous suggestions by political officials—including President Obama—that Yucca Mountain is unsafe for storing nuclear waste, the committee could not identify a single document to support such a claim. To the contrary, the committee found great agreement among the scientific and technical experts responsible for reviewing the suitability of Yucca Mountain—considered by many to be 'the most studied piece of land on Earth'—that nuclear waste can be safely stored at the site for tens of thousands of years in accordance with Nuclear Regulatory Commission . . . requirements."

In particular, the executive summary was critical of both administration and NRC actions. As it states: "Most noteworthy in this regard is Volume III of the NRC's Safety Evaluation Report (SER)—a comprehensive technical evaluation of site safety critical to advancing licensing and construction of the Yucca facility. Obtained by the committee only after repeated demands and over the objections of the NRC Chairman, SER Volume III demonstrates in excruciating detail the level of technical support among NRC and Department of Energy (DOE) experts in favor of the site's advancement: the committee found that NRC agreed with over 98.5 percent of DOE's findings regarding the site's suitability to meet regulatory requirements. The remaining 1.5 percent did not impact the NRC staff's overall conclusions, which found that DOE's Yucca Mountain License Application complies with applicable NRC safety requirements, including those related to human health and groundwater protection, and the specific performance objectives called for in NRC regulations for disposal of high-level radioactive wastes at Yucca Mountain (10 CFR 63.113-115).

"Why, then, has the president shut down the Yucca Mountain Project? And why does NRC Chairman Jaczko refuse to permit NRC safety review of the site to continue, and refuse to allow his fellow commissioners to formally vote on DOE's Motion to Withdraw the Yucca Mountain License Application? The answer is clearly not explained by or based on any scientific or technical evaluation."

In its conclusion, the executive summary states: "In closing, it should be noted that, despite the path that has been worn and the damage that has been done, the administration still has ample opportunity to make things right. Disclosing to Congress the relevant and necessary information related to the Yucca Mountain decision process, allowing formal completion of the Safety Evaluation Reports, and bringing the DOE's motion to withdraw its license application to a vote before the full Commission would go a long way to restoring public confidence in the nuclear waste management policy process."

The results of this review outline a systematic and active effort on the part of the administration to "obfuscate, delay, and muzzle scientific and technical information and related processes" in order to shut down Yucca Mountain.

The full report can be found on the Internet at http://science.house.gov.

● In a related story, the U.S. Nuclear Regulatory Commission's Inspector General (IG) has concluded a comprehensive, seven-month review of Chairman Gregory Jaczko's handling of the high-level waste program. In October 2010, Chairman Jaczko had decided that the NRC would end its review of the Yucca Mountain license application, stating

that the commission had not been allocated any more funds for this work. According to a June 8 statement by Chairman Jaczko, the IG review reaffirms "that my actions have been and remain consistent with established law, guidance, and my authorities as Chairman. With the IG report now completed, we can all more forward with a renewed commitment to ensuring public health and safety in the use of nuclear materials—the essential mission of the NRC."

Jaczko continued: "The closeout of the Yucca Mountain license review has been a complicated issue, with dedicated and experienced people holding different viewpoints. All NRC Chairmen have the responsibility to make difficult and sometimes controversial decisions. The IG plays an important role in enabling the American people to continue to have confidence that my focus as Chairman—and the entire agency's focus—is on effectively carrying out the NRC's vital safety mission. Thus, I appreciate the thoroughness with which the IG and his staff conducted this comprehensive review over the last seven months."

At press time, the IG reported had not been released to the public.

MIT Report: The Future of the Nuclear Fuel Cycle

In the wake of the crisis at Japan's Fukushima nuclear power plant, in late April the Massachusetts Institute of Technology released its final report on "The Future of the Nuclear Fuel Cycle," recommending that an interim storage solution be developed so that spent nuclear fuel can be removed from storage facilities at reactor sites and stored instead in regional medium-term repositories where it can be monitored and protected as it decays over time. This recommendation is one of several urging the United States to adopt a comprehensive policy on spent fuel, in place of today's ad hoc policy.

Specific recommendations include the following:

- Planning for long-term managed storage of spent nuclear fuel—for about a century—should be an integral part of nuclear fuel cycle design. While managed storage is believed to be safe for these periods, a research and development program should be devoted to confirm and extend the safe storage and transport period.

The possibility of storage for a century, which is longer than the anticipated operating lifetimes of nuclear reactors, suggests that the United States should move toward centralized spent fuel storage sites—starting with spent fuel from decommissioned reactor sites and in support of a long-term spent fuel management strategy.

- In the area of waste management, the report recommends that a new quasi-government waste management organization (what is sometimes referred to as a Federal Corporation or a FedCorp) be established to implement the nation's waste program. It also recommends (1) the integration of waste management with the design of the fuel cycle, and (2) a supporting R&D program in waste management to enable full coupling of fuel cycle and waste management decisions. Finally, it recommends that an integrated risk-informed waste management system be adopted that classifies all wastes according to their composition (rather than origin) and defines disposal pathways according to risk.
- In the fuel cycle area, the report recommends that for the next several decades, a once-through fuel cycle using light water reactors be the preferred economic option for the U.S. This option is likely to be the dominant feature of the nuclear energy system in the United States and elsewhere for much of this century. Improvements in light water reactor designs to increase the efficiency of fuel resource utilization and reduce the cost of future reactor plants should be a principal R&D focus.
- In the area of future nuclear fuel systems, the report recommends that integrated system studies and experiments on innovative reactor and fuel cycle options be undertaken in the next several years to determine the viable technical options, define the timelines of when decisions need to be made, and select a limited set of options as the basis for the path forward.
- In the area of nonproliferation, the report recommends that the U.S. and other nuclear supplier group countries actively pursue fuel leasing options for countries with small nuclear programs, providing financial incentives for forgoing enrichment, technology cooperation for advanced reactors, spent fuel take back within the supplier's domestic framework for managing spent fuel, and the option for a fixed term renewable commitment to fuel leasing (perhaps 10 years).
- In the area of economics, the report recommends that implementation of the first mover program (for new nuclear power reactors) of incentives should be accelerated for the purposes of demonstrating the costs of building new nuclear power plants in the U.S. under current conditions, and, with good performance, eliminating the financial risk premium. This incentive program should not be extended beyond the first movers (the first 7–10 plants),

because nuclear energy should be able to compete on the open market, as should other energy options.

- As for future research, development, and demonstration programs, the report recommended that such programs focus on (1) enhanced LWR performance and fuels; (2) a much broader set of spent fuel storage and nuclear waste disposal options than has been pursued for decades; (3) modeling and simulation capability for developing technology options and for understanding tradeoffs among options; (4) innovative nuclear energy applications and concepts, including provision of process heat to industrial applications and development of modular reactors; and (5) rebuilding the supporting R&D infrastructure, such as materials test facilities and other key facilities to enable innovative fuel cycle and reactor R&D. An estimated $1 billion annually is considered "appropriate" for supporting the R&D and infrastructure programs. Additional funding would be needed for large-scale government-industry demonstration projects at the appropriate time.

A key message of the report is that it's time to really study the underlying basis of nuclear plant technology—what kind of fuel goes in, what comes out, and what happens to it then—before focusing too much money and effort on the engineering details of specific power plant designs. The study looks comprehensively at all the various components, from mining to reactor operations all the way through to waste disposal, in a holistic way. It was funded by the Electric Power Research Institute, the Idaho National Laboratory, the Nuclear Energy Institute, Areva, GE-Hitachi, Westinghouse, EnergySolutions, and NAC International.

Participants in the study included: Steve Ansolabehere, Professor of Government, Harvard University; John M. Deutch, Institute Professor, Department of Chemistry; Michael J. Driscoll, Professor Emeritus, Department of Nuclear Science and Engineering; Michael W. Golay, Professor of Nuclear Science and Engineering; Andrew C. Kadak, Professor of the Practice, Department of Nuclear Science and Engineering; John E. Parsons, Senior Lecturer, Sloan School of Management, and MIT Executive Director, Center for Energy and Environmental Policy Research and the Joint Program on the Science and Policy of Global Change; and Monica Regalbuto, Visiting Scientist, Department of Nuclear Science and Engineering, and Department Head, Process Chemistry and Engineering, Argonne National Laboratory.

The full, 253-page report can be found on the Internet at http://web.mit.edu/mitei/research/studies/nuclear-fuel-cycle.shtml.

GAO Report: Lessons Learned from the Yucca Mountain Termination

In April, the U.S. Government Accountability Office issued report No. GAO-11-229, "Commercial Nuclear Waste: Effects of a Termination of the Yucca Mountain Repository Program and Lessons Learned," that, at the request of Reps. Fred Upton (R-Mich.), Joe Barton (R-Texas), Cliff Stearns (R-Fla.), and Greg Walden (R-Ore.), examines (1) the basis for the U.S. Department of Energy's decision to terminate the Yucca Mountain program, (2) the termination steps the DOE has taken and their effects, (3) the major impacts if the repository were terminated, and (4) the principal lessons learned.

The DOE's decision to terminate the Yucca Mountain program was made for policy reasons, the report states, not technical or safety reasons. And between 1983 and the program's termination, the DOE spent $15 billion to evaluate potential nuclear waste repository sites, evaluate the Yucca Mountain site in more depth, and develop and submit the license application for it. Some $9.5 billion of this expenditure came from the Nuclear Waste Fund, the report noted.

Once the program termination was announced, the report continued, the DOE undertook an "ambitious set of steps to dismantle the Yucca Mountain repository program." Starting in February 2010, the DOE redirected the remaining fiscal year program budget to fund closeout activities; hired a contractor to archive project documents, such as those supporting the license application; eliminated the jobs of all federal employees working on the project; terminated project activities carried out by contractors, including national laboratory scientists; terminated leases for office space; transferred dozens of truckloads of office equipment and computers to other DOE facilities and local schools; and closed out most of its 500 contracts and subcontracts. According to the GAO, "Several DOE officials told us that they had never seen such a large program with so much pressure to close down so quickly." The GAO report said it found that the DOE did not follow federal policy and guidance for planning and assessing risks of termination, and that the loss of staff with experience at Yucca Mountain could hinder the license review if the process is resumed (for example, as a result of future legal decisions). Indeed, the report noted, several stakeholders, including former DOE employees, said that former staff would not likely return to a program they felt that the administration did not support.

As for impacts of the project termination, the report not-

ed that a key benefit of terminating the program is the opportunity to seek other approaches that might achieve broader acceptance than Yucca Mountain. (And for this reason, the report noted, the DOE appointed a Blue Ribbon Commission to identify such alternatives.) If a more widely accepted alternative is identified, it carries the potential for avoiding costly delays experienced by the Yucca Mountain program. However, the report continued, there is no guarantee that a more acceptable alternative will be identified. And regardless of any alternatives later identified, the nation will still need a geologic disposal facility.

One definite effect of termination, the GAO stated, is that it restarts a time-consuming and costly process. With nearly $15 billion already spent through 2009, completing the Yucca Mountain project would have cost an additional $41 billion to $67 billion, the GAO estimated in 2009. And even though the DOE said that it is conceivable that an alternative to Yucca Mountain (such as a centralized interim storage facility) could be developed and implemented before Yucca Mountain might ever have opened, the GAO stated that there were no other permanent alternatives to the Yucca Mountain repository that could be implemented sooner than the 2020 projected date of opening the repository. Even an interim storage facility would likely take between 17 and 33 years to plan and implement (much longer than the 6 years several DOE officials estimated it would take to plan and implement such a facility, the GAO said), and interim storage is not a permanent alternative to a repository. So, by terminating work on Yucca Mountain, the DOE likely will have to restart the process for any alternative repository site, since every site is unique. Thus, the termination of Yucca Mountain could set back the opening of a new geologic repository by at least 20 years and cost billions of dollars.

Another effect of project termination is that alternative means of funding a repository project may be needed. With more than $9 billion already taken from the Nuclear Waste Fund, there may not be enough money collected over the lifetimes of the nation's current reactors to fund a repository program through the decades-long operation of such a facility. An adjustment to (i.e., increase in) the nuclear waste fee (currently at one mill per kilowatt-hour of nuclear-generated electricity) might solve the funding problem, but would have to be instituted while reactors are still operating, the GAO said; otherwise, taxpayers would end up paying more for an alternative repository. In addition, the taxpayers' liabilities because of the DOE's failure to take custody of spent fuel in 1998 (as outlined in the original Nuclear Waste Policy Act) will total about $15.4 billion by 2020 and will increase by about $500 million for each year of delay thereafter. The GAO concluded that "a more predictable funding mechanism would enhance the federal government's future efforts to develop and implement a disposal solution for the nation's spent nuclear fuel."

A final impact of terminating Yucca Mountain is that communities may be even less willing to host spent nuclear fuel repositories or other storage sites in the future due to further erosion of the DOE's credibility, the GAO stated. For this reason, the GAO stated that an independent organization, outside the DOE, could be more effective in siting and developing a permanent repository for the nation's nuclear waste.

By terminating work on Yucca Mountain, the DOE likely will have to restart the process for any alternative repository site, since every site is unique. Thus, the termination of Yucca Mountain could set back the opening of a new geologic repository by at least 20 years and cost billions of dollars.

As for lessons learned, the GAO noted "two broad lessons for future repository efforts or other nuclear waste management efforts." First, overcoming social and political opposition is crucial, and transparency, economic incentives, and education are important tools in doing so. Second, in developing a waste management alternative, it is important to have consistent policy, funding, and leadership, since any such effort will take decades.

The full report can be viewed at http://www.gao.gov.

Blue Ribbon Commission Releases Subcommittee Recommendations

As the Blue Ribbon Commission on America's Nuclear Future ponders its draft report, due in late July, the commission's subcommittees released their conclusions and recommendations, which may or may not be included in the report. The subcommittee recommendations and/or conclusions are as follows:

Transportation and Storage Subcommittee

- Draft Recommendation #1: The United States should proceed expeditiously to establish one or more consolidated interim storage facilities as part of an integrated, comprehensive plan for managing the back end of the nuclear fuel cycle.
- Draft Recommendation #2: The subcommittee has concluded that there do not appear to be unmanageable safety or security risks associated with current methods of storage at existing sites. However, rigorous efforts will be needed to ensure this continues to be the case.
- Draft Recommendation #3: Spent fuel currently being stored at decommissioned reactor sites should be "first in line" for transfer to a consolidated interim storage facility as soon as such a facility is available.
- Draft Recommendation #4: A new integrated national approach is needed to revitalize the nation's nuclear waste program. A new organization charged with developing one or more permanent disposal facilities should also develop consolidated storage and transportation capabilities.
- Draft Recommendation #5: Siting and development principles for disposal facilities should apply to interim storage facilities, and to planning for transportation needs. Processes should be science-based, consent-based, transparent, phased adaptive, and standards-driven.
- Draft Recommendation #6: The spent fuel transportation system is functioning well, and the safety record is excellent. However, planning and coordination for the transport of spent fuel and high-level waste is complex and should commence at the very start of any storage project.
- Draft Recommendation #7: Any new entity will need reliable access to financial resources. The Administration and Congress should provide full access to the Nuclear Waste Fund for the purposes for which it was intended, including funding consolidated interim storage.

Disposal Subcommittee

- Recommendation #1: The United States should proceed expeditiously to develop one or more permanent deep geological facilities for the safe disposal of high-level nuclear waste. Permanent disposal is needed under all reasonably foreseeable scenarios. Geologic disposal in a mined repository is the most promising and technically accepted option available for safely isolating high-level nuclear waste for very long periods of time.
- Recommendation #2: A new single-purpose organization is needed to develop and implement a focused, integrated program for the transportation, storage, and disposal of nuclear waste in the Unites States. The new organization should have (1) a focused and well-defined mission, (b) the financial and institutional means to deliver on its commitments, and (c) sufficient independent authority—subject to appropriate financial, technical, and regulatory oversight—to provide institutional and programmatic stability over time. Congress should play a central role in ensuring the accountability of a new waste management organization.
- Recommendation #3: Assured access to the balance in the Nuclear Waste Fund and to the revenues generated by annual Nuclear Waste Fee payments from ratepayers and utilities is absolutely essential and must be provided to the new nuclear waste management organization.
- Recommendation #4: A new approach is needed to site and develop nuclear waste management and disposal facilities in the United States in the future. We believe siting processes for all such facilities are most likely to succeed if they are consent-based, transparent, phased, adaptive, and standards- and science-based.
- Recommendation #5: The current division of regulatory responsibilities between the U.S. Nuclear Regulatory Commission and the U.S. Environmental Protection Agency is appropriate and should continue. In addition, we urge that new, site-independent safety standards be developed by the two agencies in a formally coordinated joint process that actively engages and solicits input from all the relevant constituencies.
- Recommendation #6: The roles, responsibilities, and authorities of local, state, and tribal governments with respect to facility siting and other aspects of nuclear waste disposal must be an element of the negotiation between the federal government and the other affected units of government in establishing a disposal facility. All affected levels of government (local, state, tribal, etc.) must have,

at a minimum, a meaningful consultative role in important decisions; in addition, states and tribes should retain—or where appropriate, be delegated—direct authority over aspects of regulation, permitting, and operations where oversight below the federal level can be exercised effectively and in a way that is helpful in protecting the interests and gaining the confidence of affected communities and citizens.

- Recommendation #7: The Nuclear Waste Technical Review Board should be retained as a valuable source of independent technical advice and review, and members should represent a carefully considered mix of scientists and engineers with the relevant mix of expertise.

Reactor and Fuel Cycle Technology Subcommittee

- Central Conclusion #1: Advances in nuclear reactor and fuel cycle technologies may hold promise for achieving substantial benefits in terms of broadly held safety, economic, environmental, and energy security challenges. To capture these benefits, the United States should continue to pursue a program of nuclear energy research, development, and demonstration both to improve the safety and performance of existing technologies and to development new technologies that could offer significant advantages in terms of the multiple evaluation criteria listed in our charter.
- Central Conclusion #2: No currently available or reasonably foreseeable reactor and fuel cycle technologies, including current or potential reprocess or recycle technologies, have the potential to fundamentally alter the waste management challenge this nation confronts over at least the next several decades. Put another way, we do not believe that new technology developments in the next three to four decades will change the underlying need for an integrated strategy that combines safe, interim storage of spent nuclear fuel with expeditious progress toward siting and licensing a permanent disposal facility.
- Recommendation #1: The U.S. government should provide stable, long-term research, development, and demonstration support for advanced reactor and fuel cycle technologies that have the potential to offer substantial benefits relative to currently available technologies in terms of safety, cost, resource utilization and sustainability, the promotion of nuclear nonproliferation and counter-terrorism goals, and waste storage and disposal needs.
- Recommendation #2: The subcommittee concurs with the recent findings of the President's Council of Advisors on Science and Technologies (PCAST) and recommends the need for better coordination of energy policies and programs across the federal government; for a substantial increase in federal support of energy-related research, development, demonstration, and deployment; and for efforts to explore new revenue options to provide this support.
- Recommendation #3: A portion of the federal nuclear energy RD&D resources should be directed to the U.S. Nuclear Regulatory Commission to accelerate development of regulatory frameworks and support anticipatory research for novel components of advanced nuclear energy systems. An increased degree of confidence that new systems can be successfully licensed is important for lowering barriers to commercial investment.
- Recommendation #4: The United States should continue to take a leadership role in internal efforts to address global non-proliferation concerns. This could include: support for multinational, industrial-scale fuel cycle facilities, joint efforts with other countries to improve security and accountability technologies and protocols for nuclear materials and capabilities, and improvements in existing multilateral agreement frameworks.

We do not believe that new technology developments in the next three to four decades will change the underlying need for an integrated strategy that combines safe, interim storage of spent nuclear fuel with expeditious progress toward siting and licensing a permanent disposal facility.

Additional information on the subcommittee reports can be found at http://www.brc.gov.

Areva White Paper: Recycling Provides Strategic Flexibility and Long-Term Confidence

"The deployment of proven state-of-the-art recycling technology is cost competitive, simplifies waste management, and conserves natural resources," states a white paper on building a sustainable nuclear fuel cycle issued in mid-May by Areva. The white paper is titled "Recycling: Essential Element of a Sustainable Fuel Cycle."

According to the white paper's executive summary, "The energy remaining in used nuclear fuel is a strategic resource, and we can reuse 96 percent of its energy content using proven technology. . . . The amount of used fuel stored at U.S. plant sites could power today's entire U.S. reactor fleet for six years. With recycling, we could reduce by 75 percent the volume of high-level waste . . . slated for disposal in a repository. As the experience with the Yucca Mountain project demonstrated, repository space is a rare and precious asset. In addition, Areva's recycling technology uses a specialized vitrification process that produces a simple, stable, durable waste form optimized for storage and geological disposal.

"Areva's facility design for the United States employs new technologies and engineering improvements, including the COEX™ process, which confers additional nonproliferation benefits by ensuring that no pure plutonium is separated at any point within the plant.

"Detailed studies show that deploying Areva's recycling technology would increase our nation's energy security, create jobs and investment, and improve public acceptance of nuclear energy, but would not increase electricity costs. Local public support for a recycling center is likely to prove a significant factor in the ability to gain acceptance for proposed interim used fuel storage facilities.

"There are exciting areas of research into emerging nuclear energy technologies, and this advanced research must proceed. However, many decades will pass before these technologies are ready for commercial deployment. Meanwhile, the United States has a pressing obligation to address a large—and growing—used fuel backlog. Deploying state-of-the-art recycling technology is an important first step in developing a viable integrated fuel cycle strategy. This would support our existing reactor fleet, while retaining the flexibility to pursue additional R&D on advanced fuel cycles.

"It is crucial that the Nuclear Regulatory Commission continue developing a regulatory framework for deploying commercial recycling facilities. Congress and the Administration must likewise chart a strategic course for sustainable fuel cycle management. This national policy commitment must recognize used nuclear fuel as a resource, not a waste, and facilitate the consolidation and recycling of this resource, continue R&D, and develop a national repository. Executing this policy requires an entity, such as a Federal Corporation (FedCorp), that it is broadly chartered, appropriately capitalized, insulated from political volatility, and capable of sustaining long-term projects."

To see the full white paper, go to http://us.areva.com, click on "News," click on "Archives," then click on "AREVA White Paper."

NRC Inspector General Report on Spent Fuel Storage

On May 19, the U.S. Nuclear Regulatory Commission's Office of Inspector General (OIG) issued a report on its audit of the agency's oversight of Independent Spent Fuel Storage Installation (ISFSI) safety.

Noting that the "United States has entered a period where the national policy for storing, reprocessing, and disposal of spent nuclear fuel is being reexamined," the report stated that the NRC "has been reviewing the issues associated with long-term storage."

According to the report, the nuclear industry expects that by 2025 all commercial nuclear power plants in the U.S. will have operational ISFSIs at their sites. The NRC's safety oversight program for spent fuel storage is designed to prevent radiation-related deaths and illnesses and protect the environment. The NRC periodically inspects the design, fabrication, and use of dry cask storage systems by sending inspectors to licensee and cask vendor facilities.

Although there have been no significant issues at ISFSIs, the report said, the OIG identified opportunities for improvement within the ISFSI safety inspection program in two areas: ISFSI safety inspector training and the frequency of routine ISFSI inspections.

The report noted that there is no formalized agency-wide training program for ISFSI safety inspectors. When ISFSI safety inspectors do not have a consistent understanding of agency inspection requirements, the report continued, oversight can be compromised and there is an

increased potential for inadequate inspections to occur. Currently, training requirements vary among the regional, resident, and headquarters-based inspectors. Therefore, the OIG recommended that the NRC develop and implement a formalized agency-wide ISFSI safety inspector training program.

In addition, the OIG recommended that the NRC modify inspection guidance to include a minimum inspection frequency for conducting routine ISFSI safety inspections.

The full report can be found on the Internet at http://www.nrc.gov/reading-rm/doc-collections/insp-gen/2011/.

TRU Waste Updates

● Projected budget shortfalls during fiscal years 2012 and 2013 may mean that shipments of transuranic (TRU) waste from the Oak Ridge site to the Waste Isolation Pilot Plant will be curtailed. To cut costs, the U.S. Department of Energy is proposing to defund the Central Characterization Project (CCP) at Oak Ridge for the two-year period, but to resume funding their work in fiscal year 2014. The primary work of the CCP is to certify TRU waste for disposal at WIPP.

● The F Canyon box remediation program, an American Recovery and Reinvestment Act (ARRA) project at the Savannah River Site (SRS), has begun work to process legacy transuranic (TRU) waste for shipment to the Waste Isolation Pilot Plant in New Mexico. The $40-million facility will process approximately 330 boxes containing TRU waste. The facility is designed to identify WIPP-prohibited items (typically, aerosol cans, liquids, and sealed containers), remove them, and repackage the remaining TRU waste in new 55-gallon drums. Once repackaged, the waste is sent for certification and shipment to WIPP. Some $55 million in ARRA funding will be used for the TRU waste box remediation at F Canyon. This effort is in support of the SRS's overall goal to ship 5000 cubic meters of legacy TRU waste to WIPP before December 31, 2012.

● Los Alamos National Laboratory (LANL) has reached an important milestone in its campaign to ship transuranic (TRU) waste to the Waste Isolation Pilot Plant. In May, LANL surpassed 100 000 plutonium-equivalent curies of TRU waste shipped to WIPP, about one-third of the Lab's total. About 190 000 plutonium-equivalent curies remain to be shipped in 10 000 containers currently stored above ground and another 6000 retrievably buried. The waste has been shipped from LANL to WIPP in more than 750 shipments since 1999, but in the last two years, LANL has ramped up its TRU shipping schedule, with more than 300 shipments completed safely since 2009. As remaining drums are shipped, the Lab will be demolishing unused storage facilities in a multiyear plan to close the waste site.

International Briefs

● Denmark has named six sites with potential to host a decommissioning waste disposal facility. The six sites were selected based on a geological assessment, considering potential threats to drinking water and risks of earthquakes. The decommissioning of the three test reactors at the Riso National Laboratory for Sustainable Energy is scheduled for completion in 2018. The disposal facility will have to hold an estimated 5000 cubic meters of low-level waste and 233 kilograms of spent fuel. The six sites are: Ostermarie, Bornholm council; Rodbyhavn, Lolland council; Kertinge Mark, Kerteminde council; Hvidbjerg, Thyholm, Struer council; Thise, Salling, Skive council; and Skive Vest, Skive council. Determining the final site from among the six could take several years, authorities said.

● The Kings Cliffe landfill near Peterborough in Northamptonshire, England, has been approved by the U.K. government for disposal of very low-level decommissioning waste, despite the disapproval of local residents, some 98 percent of whom voted against the waste disposal plan in local referendums. Northamptonshire county councilors had also unanimously rejected the plan in March 2010.

● In May, a peer-review group from the Organization for Economic Cooperation and Development's Nuclear Energy Agency began a year-long review of SKB's plan for a final spent fuel repository in Sweden. The review will focus on the long-term safety of the repository after the spent fuel has been loaded and the repository sealed. The review is expected to take three to four years. SKB submitted a license application for the repository to Swedish authorities in March.

● The final container of lagging material from the Calder Hall heat exchangers has been successfully dispatched from Sellafield to the Lillyhall landfull site for disposal. This marks the completion of a four-year project to remove asbestos lagging from the heat exchangers, turbine

halls, and associated plant. The material was part of one of the largest "bulk exemption" cases in the United Kingdom, with the material classified as Radioactive Substances Act exempt material that could be disposed in a landfill. Calder Hall operated for some 50 years, and was shutdown in 2003.

The U.S. Nuclear Regulatory Commission approved EnergySolutions' application to import up to 1000 tons of German low-level radioactive waste, which will be incinerated or otherwise treated at the company's Bear Creek Facility in Tennessee.

- The spent fuel store at Bulgaria's Kozloduy nuclear power plant hosted opening ceremonies on May 12; operations at the new Dry Spent Fuel Storage Facility are expected to begin by mid-2012. The facility will store all the spent fuel from the six reactors at the site, four of which have been shut down. Construction on the facility began in 2008. Ultimately, it will store 8000 VVER-440 fuel assemblies from Units 1 through 4, and 2500 VVER-1000 assemblies from Units 5 and 6.
- Ontario Power Generation (OPG) is proposing to dispose of some 200 000 cubic meters of low- and intermediate-level radioactive waste in a repository to be located at the Bruce nuclear power plant site. The facility would be built about 680 meters underground in low-permeability limestone, beneath a 200-m-thick layer of low-permeability shale. It would dispose of LLW/ILW from the Bruce, Darlington, and Pickering nuclear power plants. OPG has submitted the environmental impact statement, the preliminary safety report, and supporting documents for its repository to the Canadian Nuclear Safety Commission. Pending license approval, the facility would begin operations in the 2018 timeframe.
- In early May, another shipment of spent fuel from Italy to France was completed. Two casks left the Avogadro storage site in Saluggia on May 9 and arrived the next day at the railway terminal that serves the La Hague recycling plant. The spent fuel came from the Trino Vercellese reactor, which shut down in 1990, and the Garigliano reactor, which shut down in 1982. A 2007 contract between Areva and the Italian radioactive waste and decommissioning company Sogin covers the reprocessing of fuel from these reactors as well as from Caorso. This shipment was the second to be made from the Avogadro site and the 18th to be made between the two countries.
- Those who think that all radiation detector work is high-tech may be surprised to learn that a herd of nanny goats in the Scottish village of Shebster has played an important role in radiation monitoring near the Dounreay site in Scotland. Since the late 1990s, the herd has supplied five liters of milk every three months for sampling as part of Dounreay's environmental monitoring program. However, over fears that the aging goats in the herd might soon be unable to supply the requisite amount of milk, the goats have been retired, replaced by a younger herd of cows in Sibster.
- The SLOWPOKE-2 nuclear reactor at Dalhousie University in Halifax, Nova Scotia, has been removed. The unit resided in the basement of Dalhousie's Life Sciences Centre between 1976 and 2008. A chemistry professor and graduate students used the reactor for neutron activation analysis, but upon the professor's retirement in 2008, the university made the decision to decommission the facility. The physical removal process took three months to complete. Some parts of the reactor will be reused by other SLOWPOKE facilities at Ecole Polytechnique in Montreal and the University of Alberta in Edmonton. The facility must be released to the university by the Canadian Nuclear Safety Commission before the future use of the space can be determined. Release is expected by the end of this year.
- In early June, the U.S. Nuclear Regulatory Commission approved EnergySolutions' application to import up to 1000 tons of German low-level radioactive waste, which will be incinerated or otherwise treated at the company's Bear Creek Facility in Tennessee, with the residual ash or leftover products returned to Germany. The imported materials will consist mostly of paper, plastic, wood, textiles, glass, and metal that will have various levels of radioactive contamination. ■